

Shape selection in frustrated elastic sheets

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Many natural structures are made of soft tissue that undergoes complicated shape transformations as a result of the distribution of local *active* deformation of its "elements". In particular, complicated configurations appear in thin sheets when the active deformation leads to geometrical frustration.

We formulated effective 2D plate/shell theory for sheets with intrinsic incompatible metric and curvature tensors.

Experimentally, we use environmentally responsive gel sheets that adopt prescribed metric and curvature fields upon induction by environmental conditions. With this system we study the shaping mechanism in different cases of imposed metrics and curvature.

I will present two examples:

1. Shape selection of elastic discs with hyperbolic reference metric.
2. The formation of twisted and helical ribbons in the macroscopic elastic systems and during self assembly of nano-scale macromolecules.

While some properties of these systems are well understood, they pose some unsolved puzzles and challenges.